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Responsible Minerals Initiative Blockchain Guidelines

Second Edition

DISCLAIMER

This document was developed by the Responsible Minerals Initiative (RMI) in collaboration with interested stakeholders. The Blockchain Guidelines are a living document that is continuously updated as feedback and comments are received.

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INTRODUCTION

Blockchain technology is increasingly applied as a tool to enhance transparency in mineral supply chains with a view to determine the point of origin of minerals and metals as well as obtain and share data relative to responsible mining practices.

Blockchain-enabled solutions and projects to date are often applied by a relatively limited number of supply chain actors and lack a shared understanding of definitions, concepts and data attributes.

The RMI has developed these draft Blockchain Guidelines (herein "Guidelines") to promote:

1. The common adoption of definitions and concepts in the application of blockchain-enabled solutions in mineral supply chains.
2. Consensus on the fundamental data attributes to be included at each stage of the blockchain enabled solution in mineral supply chains.
3. Interoperability of blockchain-enabled solutions, defined in these Guidelines as the ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged.
4. Further the understanding of governance and incentive models that support a direct or indirect positive impact from the application of blockchain technology for supply chain actors and communities in mineral producing countries.

The Guidelines are inspired by the success of RMI's Conflict Minerals Reporting Template (CMRT) and, particularly, the underlying data exchange standard IPC 1755. They are agnostic to the type of operations for mineral production, trade and processing as well as the mineral or metal itself.

Blockchain technology is one tool that may be used to enhance transparency in mineral supply chains, build trust and share data between supply chain actors. The technology does not replace the need for individual companies to conduct due diligence on their mineral supply chains.

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SCOPE

The Blockchain Guidelines promote:

1. The adoption of shared definitions of terms and concepts related to mineral supply chains;
2. The development and adoptions of a unique identification system for mineral supply chain actors;
3. Consensus on fundamental data attributes for:
    a. The identification of supply chain actors;
    b. The provenance of minerals or metals transactions;
    c. The context on the origin and production of the minerals or metals.
4. The adoption of emerging technical standards on interoperability for blockchain and distributed ledger technology.

The Guidelines apply to any mineral or metal supply chain, any geography and any type of mineral/metal production. As such, the Guidelines include definitions for commonly used actors and processes in mineral supply chains. Users of the Guidelines are encouraged to use these as a basis for more specific terminology as it applies for each mineral/metal or supply chain.

This second version of the Guidelines builds on the previous edition and introduces principles for interoperability between different chain-of-custody solutions. Interoperability is widely recognized as a major factor impacting the adoption of blockchain solutions at scale.

The Guidelines focus on key requirements for solutions and do not define technical protocols for blockchains, applications or interoperability between blockchain-enabled solutions. They do not standardize upstream data expected to be reported by supply chain actors regarding their due diligence and/or responsible mining practices.

BLOCKCHAIN GUIDELINES DEVELOPMENT

The RMI applies a phased process for the development of the Guidelines:

March–November 2018: Drafting of the first version of the Blockchain Guidelines. The RMI shared draft versions of the Guidelines with any interested stakeholder throughout the process. The RMI logged and responded to 88 comments from eight (8) stakeholder groups during the consultation. Feedback from three (3) additional stakeholders was directly incorporated in the draft text.

The RMI Blockchain Workgroup reviewed all revisions to the draft in response to comments received from external stakeholders.

December 2018: Publication of the Blockchain Guidelines.

January 2019: In 2019, the RMI encouraged organizations to test the implementation of the first version of the Blockchain Guidelines.

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July 2019: The RMI expanded the working group, including Blockchain technology solution providers[1], to review and enhance the guidelines with a particular focus on foundational principles for interoperability.

February 2020: Public consultation on the second edition of the Blockchain Guidelines.

March 2020: Publication of the second edition of the Blockchain Guidelines.

[1] Circulor, IBM, Minespider, Peer Ledger

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APPLICABLE DOCUMENTS

The following documents can be used as references for the implementation of these Guidelines, to the extent specified herein. The revision of the document in effect at the time of solicitation shall take precedence.

1. International Organization for Standardization (ISO)

3166-1, alpha-2 Codes for the representation of names of countries and their subdivisions – Part 1: Country codes

3166-2 Codes for the representation of names of countries and their subdivisions – Part 2: Country Subdivision code

8601:2004 Codes for the representation of data elements and interchange formats, information interchange, representation of dates and times

ISO/DIS 22095 Chain-of-Custody Standard for the representation of terms and concepts related to the chain of custody of minerals, metals or products (*under development)*

ISO / TC 307 Blockchain and distributed ledger technologies for the standardization of blockchain technologies and distributed ledger technologies (*under development*)

2. Informative References

The following documents are for information purposes only. These documents are related to areas covered by the Guidelines but are not required for usage of the Guidelines. **This list is not exhaustive and is for indicative purposes only. It is based on the RMI's current knowledge of publicly available resources and will be updated on an ongoing basis.**

- IPC 1755 Conflict Minerals Data Exchange Standard
- Dodd-Frank Wall Street Consumer Protection Act, Section 1502
- REGULATION (EU) 2017/821 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 May 2017, laying out supply chain due diligence obligations for Union importers of tin, tantalum and tungsten, their ores, and gold originating from conflict-affected and high-risk areas.
- RMI Smelter lists and CID unique identifiers
- GS1 Standards
- OECD Due Diligence Guidance for Responsible Mineral Supply Chains from Conflict-Affected and High-Risk Areas
- OECD Due Diligence Guidance for Responsible Business Conduct
- Global Reporting Initiative, Guidance on Due Diligence Reporting (*under development*)
- Dun & Bradstreet D-U-N-S nine digit identifier for businesses

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CORE PRINCIPLES

These Guidelines are not intended to limit the development of Blockchain protocols/applications for mineral supply chains. However, the RMI believes that the relevance of blockchain-enabled solutions to support company supply chain due diligence is strengthened by:

1) their adherence to common definitions, data format rules and a shared identification system for supply chain actors;
2) their agreement on a set of fundamental attributes to identify supply chain actors, establish provenance and obtain contextual information on the origin and production of minerals and metals;
3) their ability to transfer data between different blockchain applications;
4) their ability to generate positive impact for supply chain actors and local communities in mineral producing countries.

Blockchain-enabled solutions in mineral supply chains are encouraged to integrate the following core elements in their design and implementation:

- The blockchain-enabled solution shall meet applicable legal requirements.
- The blockchain-enabled solution shall be **decentralized**, whereby "decentralized" refers to the absence of a single place where data is aggregated or controlled.
- The blockchain-enabled solution shall support **interoperability**, whereby "interoperability" is defined in these Guidelines as "*the ability of two or more systems or applications to transact with one another and to mutually use the information that has been exchanged*."
- The blockchain-enabled solution shall ensure all supply chain actors entering data are **trusted supply chain actors or meet the requirements defined for participation** in the blockchain.
- Due consideration shall be taken for the **impact and burden of implementation** on all supply chain actors. Blockchain enabled solutions should be **accessible to large, medium and small actors** (where appropriate) to enter accurate data and should be capable of working in the field where technology access is limited. At a minimum, and where applicable, ensure that artisanal and small scale miners are not excluded from the supply chain due to reduced access to technology and education.
- Due consideration shall be given to governance and incentive models that support **direct or indirect positive impact** for the supply chain actors and local communities in minerals or metals producing countries.
- Where possible and appropriate, **apply existing global standards** covering the areas of relevance to these Guidelines. Areas of relevance include[2], but are not limited to:
    - Data exchange
    - Interoperability of blockchains and distributed ledger technology
    - Chain of custody
    - Restrictions for hazardous substances
    - Supply chain due diligence
    - Responsible business conduct
    - Responsible mining practices

[2] Examples of existing standards in some of these areas are included in the section on "Informative References" of these Guidelines.

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- Supply chain data shall be **self-sovereign**, meaning no actor on the platform should be able to access supply chain data they do not own, or have not been provided access to by the owning actor.
- A governance model or consensus mechanism that includes adequate considerations on how to **protect the application against attacks**.
- Support a controlled reconciliation procedure to "adjust" transactions where discrepencies have been reported, investigated and successfully reconciled. The procedure shall use the same consensus mechanism as applied to the initial data set.
- Account for the recording of **individual transactions.**
- Apply integrity tests to transactions such as **a mass balance approach**.

DEFINITIONS

This section includes definitions of terms and concepts commonly used in mineral supply chains. It looks to promote the use of a shared lexicon in blockchain enabled solutions across different minerals, metals and supply chains. Where possible, definitions have been aligned with existing standards and guidance commonly applied in mineral supply chains.

Annual Production Volume: The annual production volume is defined as the estimated total weight of mineral ore, defined using the International System of Units (SI) at least to the first decimal place, extracted over the period of one calendar year. The estimate may be based on different sources, including, but not limited to, geological studies or previous production volumes.

Application: For the purpose of these Guidelines, the term "application" refers to a customized product leveraging blockchain technology and built on top of a blockchain protocol to facilitate a certain type of data and/or value transfer.

Attribute: A piece of information that determines the properties of a field or tag in a database or a string of characters in a display.

Batch: A specific quantity of mineral ore or concentrate that is identified using a unique identifier assigned to it (e.g., bar code, unique reference number, RFID tag or other identifier). A batch may be in bulk or contained in a bag, barrel or other container.

Blending: Blending is performed to mix ores or concentrates of varying quality with fluxes or to mix different secondary raw materials, to produce a stable and homogeneous feed. (Source: Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries. JRC Science for Policy report. 2017 - P69
http://eippcb.jrc.ec.europa.eu/reference/BREF/NFM/JRC107041_NFM_Bref_2017.pdf)

Blockchain: A distributed ledger technology used to synchronise digital records across multiple locations, which relies upon cryptography to confirm transactions.

Blockchain Event: An event that occurs in the supply chain and is recorded on the blockchain.

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Blockchain Protocol: For the purpose of these Guidelines, the term "protocol" refers to the set of rules that govern a blockchain enabled solution, including but not limited to, a consensus mechanism, transaction validation, economic incentives and participation. Blockchain protocols may be applied at different layers: A fundamental layer relating to the distributed ledger technology and an application layer relating to the customized product build on the distributed ledger technology.

Calculated Metal Weight: The weight of the metal as calculated using the weight of the mineral and the estimated or measured metal grade defined using the International System of Units (SI).

Chain of Custody: The sequence of actors who have had physical possession of the material along its journey from the source to the end point to which it is tracked

Concentrating of ore (beneficiation): Beneficiation is the improvement of the grade of ore by milling, floatation, sintering, gravity, concentration or other process. (Source: The Life Cycle of a Mineral Deposit—A Teacher's Guide for Hands-On Mineral Education Activities, 2005. Appendix 1.—Glossary)

Concentrator: An individual or company that concentrates ore.

Control point: Per the OECD Guidance, "identified points in the supply chain" are required to carry out an independent third-party audit. For the purpose of these Guidelines, "identified points" are referred to as "control points" and may include:

1) key points of transformation in the supply chain
2) stages in the supply chain that generally include relatively few actors that process a majority of the commodity
3) stages in the supply chain with visibility and control over the mineral production and trade
4) key points of leverage over mineral production and trade

(Source: Chinese Due Diligence Guidelines for Responsible Mineral Supply Chains)

Downstream: For the purpose of these Guidelines, "downstream" includes any supply chain actor or entity that is not "upstream."

Due Diligence: An ongoing, proactive and reactive process through which companies can ensure that they respect human rights and do not contribute to conflict (Source: OECD Guidance)

Due Diligence Data: For the purpose of these Guidelines, "due diligence data" refers to any qualitative or quantitative data associated with a profile or a transaction and that is used to demonstrate conformance with the OECD Guidance.

Export: The process of sending mineral containing substances or products from one country to another country.

Extraction: The process to separate the mineral ore from the mineralized rock. The extraction takes place at the mine. The extraction process may include basic processes to wash, crush or otherwise remove gangue material and impurities from the mineral ore.

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Grade: The quantity of metal or metal substances (e.g., oxides, sulphides or silicates) in a sample of mineral ore; normally expressed as a percentage of the total weight. (Source: ICGLR Certification Manual, Definitions)

Import: The process of receiving mineral containing substances or products from another country.

Independent third-party assessment: A formalized evaluation of an entity, carried out by independent third-party against criteria established independent of the assessed entity, typically resulting in a report containing specific findings. For the purpose of these Guidelines, the term "assessment" is used to cover any type of assurance, audit or certification engagement.

Institutionalized mechanism: An organization created by and comprised of representatives of governments, industries and civil society with a mandate to support and advance some or all of the recommendations of OECD Guidance. (Source: OECD Guidance)

Joint initiative: An initiative enabling cooperation between supply chain actors on responsible supply chain management meeting the due diligence principles, standards and processes of the OECD Guidance and which may support and/or implement some or all of the recommendations of the OECD Guidance.

Interoperability: The ability of two or more systems or applications to transact with one another and to mutually use the information that has been exchanged (Source: ISO / IEC 17788:2014(en).

Manufacturer: For the purpose of this Guidelines, a manufacturer refers to a company that makes products and where the metal is added into a product and/or a product containing metals is further processed or assembled.

Mass balance: A consideration of the input, output and distribution of a substance between streams in a process or stage[3].

Metal: A class of chemical elements that have a characteristic luster, are good conductors of heat and electricity, and are opaque, fusible, and generally malleable and ductile. (Source: The Life Cycle of a Mineral Deposit—A Teacher's Guide for Hands-On Mineral Education Activities, 2005. Introduction)

Metal Weight: The weight of the metal at the stage of smelting, refining, alloying or manufacturing, defined using the International System of Units (SI) at least to the first decimal place.

Mine: The source of a mineral and the point of extraction of the mineral, to the greatest possible specificity.

Mine Location: The GPS coordinates of the point of extraction.

[3] https://www.collinsdictionary.com/dictionary/english/mass-balance

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Mineral: A mineral is a **naturally occurring inorganic chemical substance**[4] that can be contained in an ore or concentrate of that ore. The mineral is usually extracted from the ore sequentially through mining, concentrating and then smelting/refining.

Mineral Weight: The weight of the mineral at the stage of extraction, handling, trading or transporting before the smelting or refining process, defined using the International System of Units (SI) at least to the first decimal place.

Mineral Byproduct: A material produced while mining or processing another material, not the primary intended product but nevertheless a separate useful material. (Source: OECD Guidance, Gold Supplement)

Mineral Concentrate: A mineral that has undergone primary treatment to increase metal content and will undergo further chemical or metallurgical processing before use.

Mineral Ore: The naturally occurring material from which a mineral or minerals of economic value can be extracted. (Source: The Life Cycle of a Mineral Deposit—A Teacher's Guide for Hands-On Mineral Education Activities, 2005. Introduction)

OECD aligned/alignment: Confirmation by a third-party assessment that activities of a joint initiative or institutionalized mechanism are rated as "fully aligned" in accordance with Section 4 of the OECD Alignment Assessment Methodology and Tool 2018 Section B '*Alignment of programme requirements with the five-step due diligence framework'*; https://mneguidelines.oecd.org/industry-initiatives-alignment-assessment.htm (Source: European Commission, Delegated Act of 11.1.2019, Art. 4.2)

OECD Guidance: OECD Guidance for Responsible Mineral Supply Chains from Conflict-Affected and High-Risk Areas, Edition 3.

Origin: For the purpose of these Guidelines, the origin of metal or minerals is defined as follows:

- The mine where the mineral or metal is extracted (*see also: "point of extraction" and "mine"*) for primary material;
- The point where the mineral or metal is returned to a smelter or other downstream intermediate processor or recycler for recycled/scrap material;
- The point where the mineral or metal is extracted and refined from the final residue of the primary material for byproducts.

(Source: OECD Guidance, Gold Supplement)

Ownership: The ultimate and exclusive right conferred by a lawful claim or title, and subject to certain restrictions to enjoy, occupy, possess, rent, sell, use, give away, or even destroy an item of property. (Source: Business Dictionary)

Plausibility: The comparison of the estimated annual production volume of a point of extraction with the actual volume produced over the same period.

[4] Source: Oxford English Dictionary

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Point of Extraction: The point of extraction may be the mine pit or the mine site, depending on the type of mining operations.

Possession: The exclusive control and use of, a material object or property resulting from the fact of holding it (whether rightly or wrongly) in one's power. (Source: Business Dictionary)

Product: Any substance, material, sub-part, part, sub-assembly, or assembly up to a completed original manufacturer's assembly that is the subject of a declaration. A product can also be referred to as a "good". (Source: IPC 1755 Standard)

Product Information: The product object is an identification of a product or group of products to which information is associated. Each product object may represent one or more products as defined in the product ID fields.

The product object may contain a single product number, multiple product numbers, or a single product number representing an entire family of products. The requester and supplier are advised to clarify the correspondence between requester product identification and supplier product identification to ensure that supplier information associates correctly with requester product numbers. (Source: IPC 1755 Standard)

Profile: The entirety of data attributes associated with a single unique identifier.

Recycled / scrap material: Reclaimed end-user or post-consumer products, or scrap processed metals created during product manufacturing. Recycled metal includes excess, obsolete, defective, and scrap metal materials which contain refined or processed metals that are appropriate to recycle in the production of tin, tantalum, tungsten and/or gold. Minerals partially processed, unprocessed or a bi-product from another ore are not recycled metals. (Source: OECD Guidance)

Responsible Mining: For the purpose of these Guidelines, "responsible mining" seeks to ensure the extraction of minerals and metals balances the delivery of economic and social benefits to host communities and nations, respect for the environment while providing financial returns to investors. Success in achieving this balance lies in the concept of 'sustainable development' whereby the needs of the present are met without compromising the ability of future generations to meet their own needs[5]. The focus of responsible mining is on how mining, minerals and metals can contribute to sustainable development, even after an operation closes. (Source: International Council for Mining and Metals)

Responsible Mining Data: For the purpose of these Guidelines, "responsible mining data" refers to any qualitative or quantitative data associated with a profile or a transaction and that is used to demonstrate responsible mining practices.

Smelter: A smelter or refiner company is a company that procures and processes mineral ore, slag, metal concentrate and/or materials from recycled or scrap sources into refined metal or metal containing intermediate products. The output can be pure (99.5% or greater) metals, powders, ingots, bars, grains, oxides or salts. The terms "smelter" and "refiner" are used interchangeably throughout various publications. For clarification purposes, within this standard they will be referred to as a

[5] The 'Bruntland Report': http://www.un-documents.net/our-common-future.pdf

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"smelter". (Source: IPC 1755 Standard) A smelter may also be a mineral importer and / or a metal or product exporter.

Supply Chain Actor: For the purpose of these Guidelines, a supply chain actor is any individual or business entity that produces, transports, trades, processes or otherwise handles minerals or metals.

Traceability*:* the ability to verify the history of a material

Trader: An individual or company that buys and sells mineral containing substances or products without altering their physical or chemical state. This may include mineral, metal or product importers or exporters. (Source: RMI SnTa Smelter Standard).

Transaction: For the purpose of these Guidelines, the term "transaction" refers to records of events during the lifecycle that together combine to provide traceability.

- **Transaction Time**: Time at which the transaction occurred and/or was lodged (if done in real time). All system time stamps should be recorded in Greenwhich Mean Time (GMT) regardless of the local timezone where the transaction takes place.

Transformation: The altering of the properties of the mineral or metal using extraction, chemical and/or metallurgical methods.

Transporter: An individual or company that transports mineral containing substances or products without altering the physical or chemical state of the mineral. A transporter does not take ownership of the minerals in its custody.

Trusted Supply Chain Actor: For the purpose of these Guidelines, a trusted supply chain actor is an entity that is considered credible by the other users of the blockchain-enabled solution and whose blockchain data entries are considered credible.

Upstream: For the purpose of these Guidelines, upstream means the mineral supply chain from the mine to smelters/refiners. "Upstream" include miners (artisanal and small-scale or large-scale producers), local traders or exporters from the country of mineral origin, international concentrate traders, mineral re-processors and smelters/refiners. (Source: OECD Guidance)

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INTEROPERABILITY

Interoperability refers to the ability to transfer chain of custody and related responsible sourcing information from one blockchain protocol to another (regardless of the distributed ledger technology used).

The Guidelines identify two scenarios:

1. Interoperability refers to the situation where multiple independent applications use the same underlying blockchain protocol and/or distributed ledger technology to transfer a common set of data, or;
2. Interoperability refers to a situation where two or more applications are based on different blockchain protocols, which may be based on different distributed ledger technology, but maintain the ability to exchange data from one platform to another.

This section focuses on the the elements required for applications to exchange data from one platform to another, to enable end-to-end traceability and the exchange of due diligence data. These Guidelines assume that a digital representation of a specific batch of a commodity cannot exist at the same time on two different Blockchain Protocols or Applications and so that batch of a commodity cannot be double-counted.

The following areas are defined in the next sections to enable the ability of different applications to exchange data:

1. Core technical processes and concepts required for interoperability
2. Unique identifiers for supply chain actors
3. Fundamental data attributes
4. Incentives for collaboration

TECHNICAL PROCESSES AND CONCEPTS FOR INTEROPERABILITY

In principle, the Guidelines support the adoption of existing or emerging global standards. Specifically for interoperability, blockchain-enabled solutions are encouraged to follow the development of and, where possible, adopt the ISO / TC 307 Standard on blockchain and distributed ledger technologies.

Transactions may be made between two blockchain-enabled solutions or from an off-chain solution to a blockchain-enabled solution.

Where multiple platforms are involved, the following key elements are required to ensure the integrity of the data associated with the transaction:

- The time stamp of the transaction from one platform to the other.
- The fundamental attributes of the batch of material associated with the transaction.
- A specific batch of material may not exist at the same time on two systems. The history of that batch may remain on the initial platform, but after transfer of that batch to another system, it

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can no longer be tracked on the original system. It is expected that a cross-chain transaction would include:
    - An exit event from one ledger and an entry event on the other ledger.
    - A handshake between the two systems confirming that the transfer of chain of custody has occurred.
- Transfer of supporting data about the history of a batch of material. This data may be stored either on-chain or off-chain by the sending or receiving party.

In addition:

- The solution providers contemplating cross-chain transactions should check that the other party/parties meet the credibility requirements for solution providers.
- It is recognized that mineral supply chains are complex and upstream conditions can make complete data capture challenging. This reality, coupled with the differing requirements of downstream customers of traceability, may result in data gaps. Traceability providers and their customers should work together to drive progressive improvements in data quality over time.

UNIQUE IDENTIFICATION SYSTEM

Mineral supply chains are composed of individuals and/or business entities involved in the production, processing, transporting, trade or handling of minerals or metals. Each entity is defined by the type of business operation(s) it is involved in. The single unique identifier allows the linkage of the entity to the other data system, as long as these equally refer to the single unique identifier. The single unique identifier further allows the linkage of individual transactions of minerals, metals, scrap or products from one entity to another.

Each entity that owns or possesses the mineral, metal, scrap or product shall be assigned a unique identifier. The identifier shall be automatically assigned by an established identification system and linked to either a single location, individual or business. The unique identifier will be fixed for the entity and may only be changed if there is a change to the entity's business operations impacting the ownership and/or possession of the mineral, metal or product.

It is expected that multiple names or aliases could be used to describe a single location, individual or business and therefore multiple names or aliases could be associated to a single unique identifier. (Source: IPC 1755)

A single unique identifier may be linked to one or multiple supply chain elements (e.g., an exporter identifier can be associated with extraction, transport, trading and export). Each single unique identifier is associated with a profile, which includes all the supply chain elements associated with the single unique identifier.

In principle, the Guidelines support the adoption of existing or emerging global standards. Specifically for the single unique identifier in mineral supply chains, blockchain-enabled solutions are encouraged to use the six-digit CID numbers for upstream actors and the six-digit CID and/or the nine-digit D-U-N-S numbers for downstream actors:

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570 *Table 1: CID Identification System*

Supply Chain Actor	CID Category
Mine: For mechanized mining, a unique identifier assigned to a single mine **location** according to an established identification system. For artisanal mining, a unique identified is assigned to a single **mine location or an individual** miner according to an established identification system. Each mine ID linked to a location is expected to be associated with a mine pit or mine site location, specified by GPS coordinates.	Starting at CID100001
Transporter: A unique identifier assigned to a single **individual or business** according to an established identification system.	Starting at CID200001
Blender: A unique identifier assigned to a single **location** according to an established identification system.	Starting at CID300001
Concentrator: A unique identifier assigned to a single **individual or business** according to an established identification system.	Starting at CID400001
Smelter or Refiner: A unique identifier assigned to a single smelter or refiner **location** according to an established identification system.	Starting at CID000001[6]
Recycler: A unique identifier assigned to a single recycler **location** according to an established identification system.	Starting at CID1200001
Trader: A unique identifier assigned to a single **business** according to an established identification system.	Starting at CID500001
Exporter: A unique identifier assigned to a single **individual or business** according to an established identification system.	Starting at CID600001
Importer: A unique identifier assigned to a single **individual or business** according to an established identification system.	Starting at CID700001
Individual: A unique identifier assigned to a single **individual** according to an established identification system.	Starting at CID1400001
Business Unit: A unique identifier assigned to a single business unit **location** according to an established identification system.	Starting at CID1300001
Manufacturer: A unique identifier assigned to a single manufacturer **location** according to an established identification system.	Starting at CID800001
Wholesale/Retail: A unique identifier is assigned to a single **location** according to an established identification system.	Starting at CID900001
Technology Service Provider: A unique identifier is assigned to a single **individual or business** according to an established identification system.	Starting at CID1100001

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[6] At the time of drafting of these Guidelines, approximately 3450 CID numbers have already been assigned to alleged and confirmed smelters and refiners.

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In addition to a CID and/or D-U-N-S number, blockchain-enabled solutions may record any unique identifier associated with the entity and that is associated with traceability and/or due diligence data pertaining to the entity.

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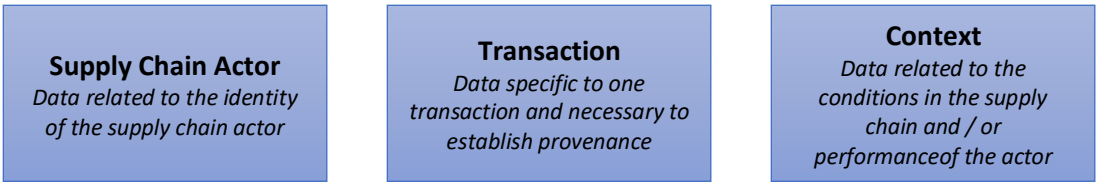
FUNDAMENTAL ATTRIBUTES

Fundamental attributes, as defined in these Guidelines, represent the minimum data to be captured using the blockchain-enabled solution to achieve the following objectives:

1. Identify each supply chain actor in a mineral supply chain;
2. Establish the origin for each transaction of minerals or metal that is traded on the blockchain;
3. Provide or reference contextual data regarding the conditions at and/or performance of key supply chain actors, at a minimum including mine(s) and smelter(s);
4. Establish the credibility of the data on the blockchain.

Blockchain-enabled solutions may capture additional data to meet their own customer requirements.

The Guidelines differentiate between three types of data:



1. Supply Chain Actor

Each supply chain actor has a single unique identifier that is linked to a profile. The profile includes fundamental attributes to determine the identity and type of business operations as well as the mineral(s) or metal(s) associated with the entity. Recommended data to provide includes:

- The single unique identifier;
- Name of the supply chain actor;
- All supply chain elements carried out by and associated with the single unique identifier (refer to Tables 1 and 2 in the section on Supply Chain Elements).
- Data to identify the supply chain actor:
    - Where the single unique identifier is based on the supply chain actor's location:
        - Street Address
        - City
        - State / Province, using the ISO 3166-2 codes for the representation of names of countries and their subdivision
        - Postal Code
        - Country, using the ISO 3166-1 alpha-2 codes for the representation of countries.
        - For a mine only: GPS coordinates (except where the single unique identifier is associated with an individual artisanal miner)
    - Where the single unique identifier is based on the supply chain actor's business:
        - Business identification number (e.g., business license, tax identification or other unique number)
    - Where the single unique identifier is based on an individual supply chain actor:
        - Name
        - Email
        - Phone

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- The metal name(s);
- The hash for each transaction associated with the single unique identifier.

2. Transaction

A transaction involves at least two profiles as the ownership and/or possession of the mineral, metal, scrap or product is transmitted from one entity with a unique single identifier to another.

Each transaction recorded shall be linked, at any point in time, to a single unique identifier for ownership and a single unique identifier for possession.

The transaction may be linked to two single unique identifiers where the entity that owns the mineral, metal or product is not the same as the entity that possesses the mineral, metal or product. The transaction may be linked to one single unique identifier where the ownership and possession of the mineral, metal or product overlap. For example:

- Material ownership may be transferred with the possession of the mineral, metal or product;
- Material ownership may be transferred without a change in the possession of the mineral, metal or product (e.g., where minerals are already in the custody of a refiner after assaying/appraisal); or
- Possession of the mineral, metal or product may be transferred without a change in material ownership (e.g., in tolling agreements, transportation or storing).

At a minimum, each transaction should include the following attributes:

- A hash unique to the transaction
- The single unique identifier at the beginning of the transaction
- The single unique identifier at the end of the transaction
- Primary metal name

In addition, each transaction should include the following attributes for:

Upstream supply chains:

- Grade (based on assay or estimates)
- Mine location
- Ore/concentrate weight (wet or dry)
- Calculated metal weight
- Export documentation complete (if required)

Downstream supply chains:

- Product information

3. Context

Fundamental attributes related to the context in supply chains serve to provide data beyond the identity of supply chain actors and the provenance of material, with the objectives to:

1. Build trust in the data entered into the blockchain-enabled solution;
2. Support the identification, assessment and mitigation of risks in mineral supply chains; and
3. Understand the impact of supply chain due diligence on supply chain actors and local communities in mineral producing countries.

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Contextual data varies greatly, depending on the type of mineral production, the mineral or metal, the producing country and supply chain actors' interest and priorities. These Guidelines recognize the different needs of blockchain users. In this section, the Guidelines provide an overview of the types of contextual data blockchain-enabled solutions may consider to include.

In general terms, contextual data can be separated into:

1. Data directly related to a supply chain actor;
2. Data that is not directly related to a supply chain actor.

Contextual data on supply chain actors

For the purpose of these Guidelines, supply chain actors on a blockchain-enabled solutions include two types:

- Trusted supply chain actors:
  A trusted supply chain actor refers to an entity that is considered credible by the other users of the blockchain-enabled solution and whose blockchain data entries are considered credible. Blockchain-enabled solutions may conclude that a supply chain actor is trusted in several ways:
  - Supply chain actors are required to meet certain conditions prior to being allowed to join a private blockchain. Blockchain-enabled solutions should be able to demonstrate to their users how they ensure trusted supply chain actors meet the required conditions. Blockchain-enabled solutions may apply a risk-based approach to conclude that a supply chain actor is trusted. This could include a review of the supply chain actor's type of business operation, physical access to the material or access to data stored on a blockchain with a view to determine the risks for data manipulation (e.g., a wholesaler/retailer, an international transportation company or a trader that does not physically move minerals/metals).
- Other supply chain actors:
  Supply chain actors may be required to meet certain conditions during the time that they participate in the blockchain-enabled solution. Blockchain-enabled solutions should be able to demonstrate to their users how they ensure that the supply chain actors continue to meet the required conditions.

  Conditions could include:
  - Evidence of participation in an OECD-aligned joint inititiave or institutionalized mechanism for due diligence.
  - Evidence of an independent third-party assessment of the actor's performance on social and environmental issue areas.
  - Any other conditions as defined by the blockchain enabled solution's governance structure.

  Evidence of participation and/or assurance, assessment or certifications could include, at a minimum:
  - Affiliation: name of the joint initiative/institutionalized mechanism or organization in which the supply chain actor participates.
  - Validity start date: start date of membership or of the period of validity of an independent third-party assessment.

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- Validity end date: end date of membership or of the period of validity of an independent third-party assessment.

Other contextual data:

Additional data that is not directly related to a supply chain actor may be captured in a blockchain-enabled solution to inform the risk identification, assessment and mitigation in mineral supply chains. Such data may vary significantly depending on the stated objectives of the blockchain-enabled solution, the material and geographies covered and the relationships between the supply chain actors and external stakeholders.

Examples of other contextual data include:

- Country risk data (e.g., governance, human rights, security or political stability indices)
- Local communities (e.g., number and size of households, gender ratio, household income, level of schooling)
- Supply chain incidents (e.g., incident reports, mitigation plans, corrective action plans)
- Company disclosures (e.g., payment to governments, GHG emission targets)

4. Blockchain Events

At a minimum, the following events are expected to be recorded on the blockchain:

- Original production of the mineral, metal or product;
- A change in ownership of the mineral, metal or product;
- A change in possession of the mineral, metal or product;
- A change to the fundamental attributes (including the material) associated with the single unique identifier;
- A change to the fundamental attributes associated with the profile.

5. Transformation

Minerals and metals may be transformed using extraction, chemical and/or metallurgical methods. Material may also be blended, disaggregated, transported or traded without any transformation of the mineral or metal itself.

Each transformation of the mineral, metal or product is expected to be carried out within defined parameters. Minerals, metals or products that undergo a transformation need to ensure incoming transactions are linked to outgoing transactions. Supply chain elements concerned are defined in Tables 1 and 2.

Transformation parameters may be entered manually to the blockchain and include the following possibilities:

- **Single transaction traceability:**

  Direct link between one incoming transaction unique identifier and one outgoing unique identifier. Such linkage could be verified by production records.

- **Batch traceability**:

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- Direct link between multiple incoming transactions unique identifiers to one outgoing transaction unique identifier (a batch); or
- Direct link between one incoming unique identifier (a batch) to multiple outoing transaction unique identifiers; or
- Direct link between multiple incoming transaction unique identifiers (a batch) to multiple outgoing transaction unique identifiers (a batch).
- Such linkage could be verified by production records.

- **Mass balance approach:**

In the mass balance approach there is no direct link between incoming and outgoing unique identifiers. This approach serves to demonstrate that an equal volume of minerals or metals is received from the blockchain prior to the transformation and is returned to the blockchain after the transformation, subject to the transformation parameters.

E.g., A smelter may purchase 10 tons of mineral concentrate via the blockchain solution. The concentrate has a metal concentration of 40 percent. Following the smelting process, and based on the transformation parameters defined for the type of metal and type of operations of the smelter, the smelter may enter four tons of refined metal of a grade of 99 percent or higher on the blockchain.

Parameters for acceptable material losses (actual or estimated) during transformation may be defined by blockchain participants, subject to the governance model or consensus mechanism.

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INCENTIVES FOR COLLABORATION

Supply chain actors who may rely on data from more than one blockchain platform should work together to ensure that fair economic value is attached to the data so that no disincentive to interoperability is created when systems need to work together to provide traceability.

It is expected that when a cross-chain transaction is necessary, that some payment for the data that is inherited will be required. It is for the actors involved to decide what is fair and reasonable in the particular circumstances, noting that a variety of payment models are possible.

DATA PRIVACY

Confidentiality and antitrust obligations are imposed on all “accredited ” service providers for supply chain or customer data where sharing, interchange, or pooling of data is required.

All solution providers must have a data privacy and data processing policy and make it available to counterparts when interoperability is required, so that supply chain actors understand how their data will be used and the degree of confidentiality that will be applied.

Personal data stored in a blockchain-enabled solution should comply with good practices for data privacy. An example of such good practice includes the EU General Data Protection Regulations (GDPR).

Where supply chain data is stored off-chain, a lookup capability must be provided to enable the history of material whose chain of custody has transferred to another blockchain platform to be accessed.

Consideration should also be given to measures to maintain appropriate privacy of data that was collected in a private blockchain and will subsequently be stored in a public blockchain.

REQUIREMENTS FOR TECHNOLOGY PROVIDERS TO INTEROPERATE

Nothing in this section is intended to prevent innovation, competition or new entrants. Piloting a solution is allowed, but a solution provider may not connect to another technology provider for interoperability without meeting at least one of these conditions.

To maintain trust in traceability data, a technology provider operating a blockchain-enabled solution needs to achieve a minimum level of trust before it may connect to other providers’ systems for interoperability purposes. This shall be demonstrated by confirmation from customers or via a third party. Acceptable options for meeting minimum acceptable requirements:

1. At least one RBA or RMI member (not a vendor member) should confirm that they use the production system operationally for traceability and that they believe the technology provider can credibly meet the standards defined in these guidelines. If a technology provider is themselves an RBA or RMI member, then another RBA or RMI member must provide that confirmation. Self-confirmation is not acceptable.

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2. The technology provider must provide references to current customers, who must confirm that they use the production system operationally for traceability and that they believe the technology provider can credibly meet the standards defined in these guidelines.

3. The technology provider can demonstrate it meets the standards defined in these guidelines by having been assessed by an independent third party who certifies that the system meets these Guidelines.

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SUPPLY CHAIN ELEMENTS

This section provides an overview of commonly identified supply chain entities, based on the types of business operations. Tables 1 and 2 demonstrate typical inputs and outputs for each supply chain entity and indicate whether the mineral or metal is expected to undergo a transformation. **This section is intended as a resource to identify the main entities that would require a single unique identifier as well as the types of transactions commonly associated with each type of business operations. It is not exhaustive and is for indicative purposes only.**

Table 1 summarizes the main elements in mineral supply chains where minerals, metals or scrap are processed between the point of extraction and the integration of a metal product into the product manufacturing process:

Table 1: Supply Chain Elements with Transformation

SUPPLY CHAIN ELEMENTS WITH TRANSFORMATION					
	Extraction	**Concentration**	**Smelting**	**Refining**	**Manufacturing**
Definition	The process to separate the mineral ore from the mineralized rock. The extraction takes place at the mine. The extraction process may include basic processes to wash, crush or otherwise remove gangue material and impurities from the mineral ore. The extraction process is the first point where the mineral grade can be determined for a transaction of mineral ore.	The process to improve the grade of ore by milling, floatation, sintering, gravity, concentration or other process. The concentration of the mineral to increase the percentage of metal contained by weight. Concentration may occur at different stages in the supply chain, typically at the mine or at the export level in the mineral producing country.	Smelting refers to the chemical or metallurgical process to extract metal from the mineral ore, slag, metal concentrate and/or materials from recycled or scrap sources. Smelting takes place at a smelter and may or may not include refining of the mineral.	Refining is the process to purify metal with a view to increase the grade. Refining can be a multi-stage process and may or may not include smelting of the mineral.	For the purpose of these Guidelines, manufacturing involves two stages: (1) the addition of metal into a product; or (2) the further processing or assembling of a product containing metals. The metal does not undergo any treatment during this process.
Main Single Unique Identifiers	Mine ID	Mine ID	Smelter ID	Smelter ID	Manufacturer ID

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Ownership Change	Yes or No A change of ownership is possible where a mine is owned and operated by two different parties.	Yes or No A change of ownership is possible where concentration may be carried out by a third party.	Yes	Yes	Yes
Possible Linked Single Unique Identifiers	Exporter ID	Concentrator ID Exporter ID	Importer ID	Importer ID	Exporter ID Importer ID
Input	Mineralized rock	Mineral ore	Different inputs are used including mineral ore, mineral concentrate and recycled/scrap material	Different inputs are used including metal products obtained in the smelting process and recycled/scrap material	Metal or other product containing metal
Output	Mineral ore	Mineral concentrate	Different forms of metal products	High-purity metal	Product containing metal
Transformation Parameters		The outgoing transaction must be linked to all the incoming transactions used to produce it.	The outgoing metal transaction must be linked to all incoming transactions used through a mass balance approach, batch or single transaction traceability.	The outgoing product information must be linked to all incoming transactions used through a mass balance approach, batch or single transaction traceability.	The outgoing product information must be linked to all incoming transactions used to produce it.

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Table 2 summarizes the main supply chain elements associated with the handling, trade and transport of minerals, metals, scrap or products where the material does not undergo a chemical or metallurgical transformation:

Table 2: Supply Chain Elements without Transformation

SUPPLY CHAIN ELEMENTS WITHOUT TRANSFORMATION						
	Blending	**Transportation**	**Trade**	**Disaggregation**	**Export**	**Import**
Definition	The process of mixing ores or concentrates of varying quality with fluxes or to mix different secondary raw materials, to produce a stable and homogeneous feed.	The physical movement mineral containing substances from one point to another in the supply chain, without altering the physical or chemical state of the mineral. A transporter does not take ownership of the minerals in its custody.	The buying or selling of mineral containing substances, without altering their physical or chemical state. Trade may include other supply chain elements, such as aggregation or concentration.	The process of disaggregating a larger batch of mineral ore or mineral concentrate into smaller batches. Previously aggregated mineral ore or mineral concentrate may be mixed with new mineral ore or mineral concentrate batches during the process. The mineral ore or concentrate are not subject to any treatment during this process.	The process of sending the mineral, metal or product from one country to another country. Legal ownership is often transferred from the entity in the exporting country to the entity in the importing country during this process.	The process of receiving the mineral, metal or product from another country. Legal ownership is often transferred from the entity in the exporting country to the entity in the importing country during this process.
Main Single Unique Identifiers	Blender ID	Transporter ID	Trader ID	Trader ID	Exporter ID	Importer ID
Ownership Change	No	No	Yes	No	Yes	Yes
Possible Linked Single Unique Identifiers	Mine ID Exporter ID	Mine ID Blender ID Trader ID Exporter ID Importer ID	Exporter ID Importer ID	Blender ID	Trader ID	Trader ID

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		Smelter ID				
Input	Mineral ore or concentrate	Mineral ore, mineral concentrate, metal or product	Mineral ore, mineral concentrate, metal or product	Mineral ore or concentrate	Mineral ore, mineral concentrate, metal or product	Mineral ore, mineral concentrate, metal or product
Output	Mineral ore or concentrate	Mineral ore, mineral concentrate, metal or product	Mineral ore, mineral concentrate, metal or product	Mineral ore or concentrate	Mineral ore, mineral concentrate, metal or product	Mineral ore, mineral concentrate, metal or product
Transformation Parameters	The outgoing transaction must be linked to all the incoming transactions used to produce it.	N/A	N/A	The outgoing transaction must be linked to all the incoming transactions used to produce it.	N/A	N/A

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APPENDIX 1: MATERIALS' FLOW

Material supply chains vary in their structure and complexity. To support these Guidelines, this Appendix provides simplified examples of simple and complex mineral supply chains as well as simplified supply chain examples for selected minerals.

The Appendix serves to inform users about common supply chain structures and how these are linked to the singe unique identifiers. **It is not exhaustive and is for indicative purposes only.**

Figure 1: Simple Supply Chain Example

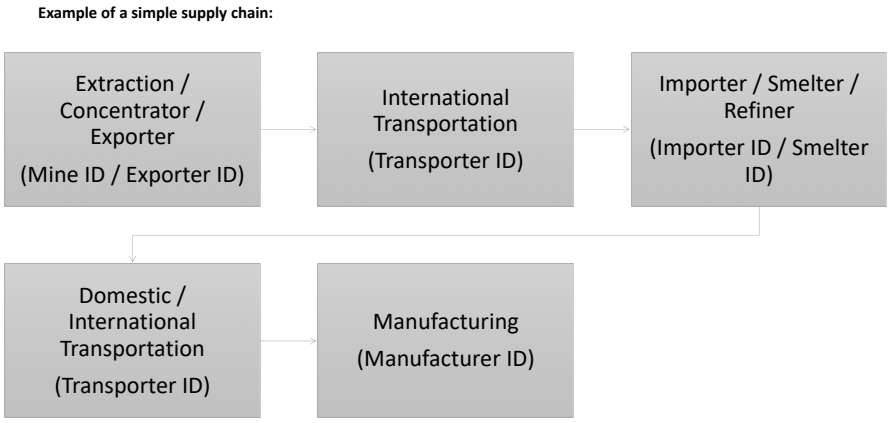
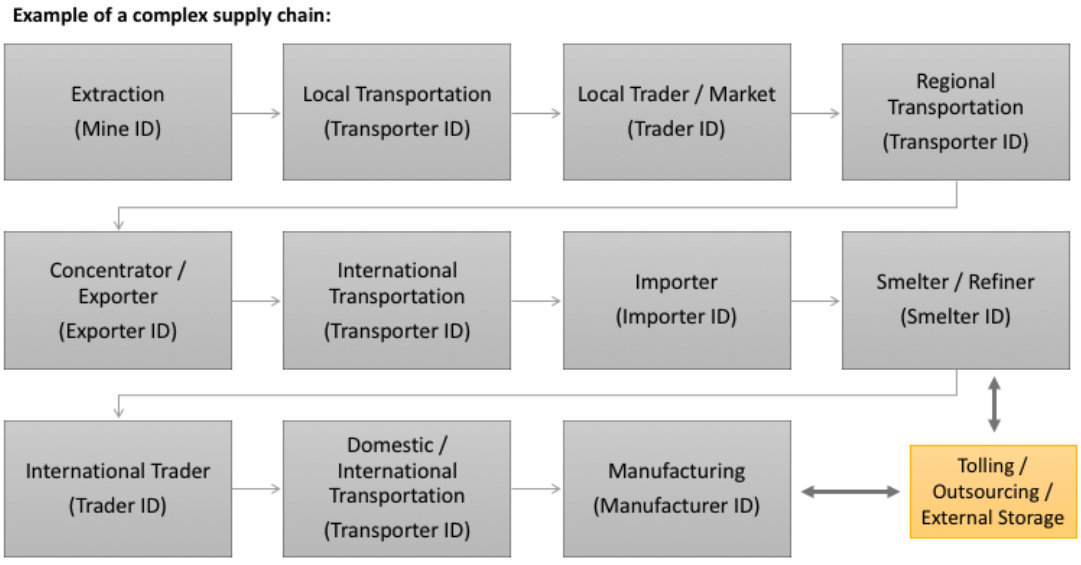


Figure 2: Complex Supply Chain Example



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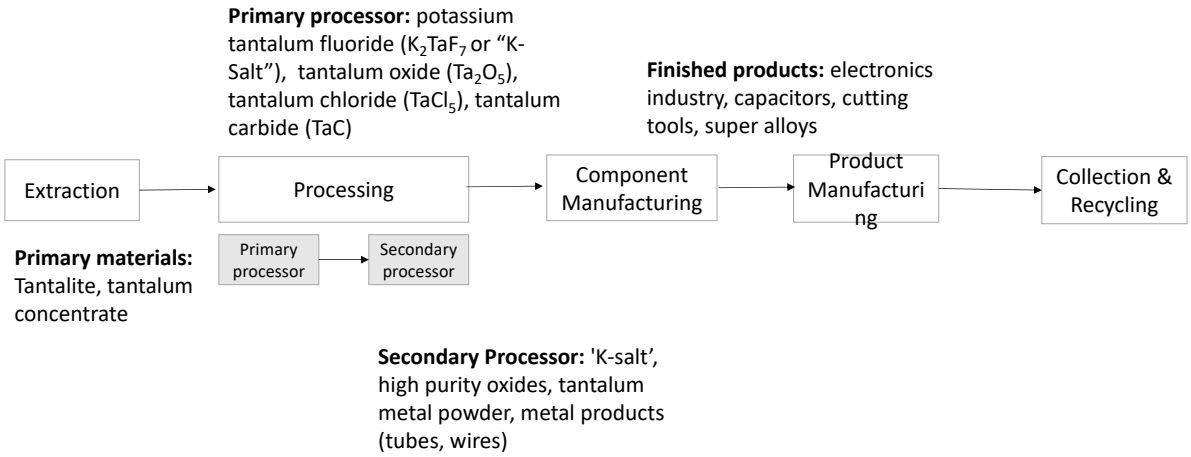
Specific Material Supply Chains

1. Tantalum

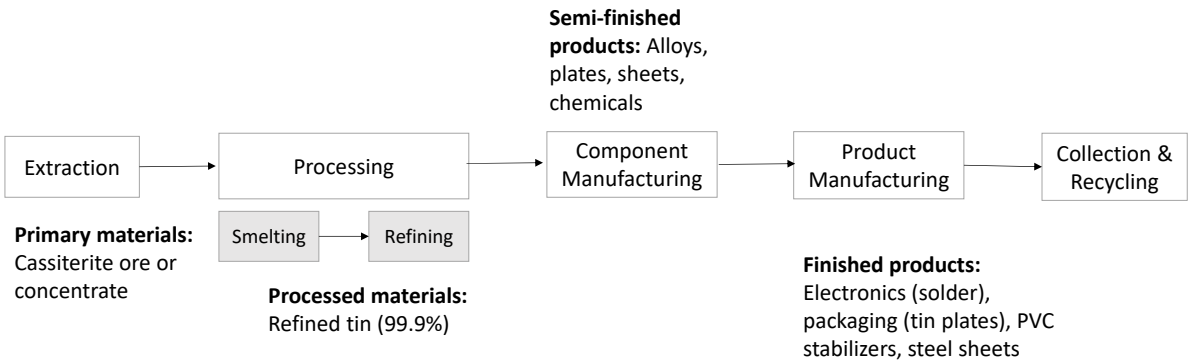
Figure 3: Simplified tantalum value chain



(Source: Tantalum and Niobium International Study Center (TIC), accessed on: https://www.tanb.org/about-tantalum)

2. Tin

Figure 4: Simplified tin value chain



(Source: European Commission Non-Critical Material Factsheet on tin, p.435, accessed on https://publications.europa.eu/en/publication-detail/-/publication/6f1e28a7-98fb-11e7-b92d-01aa75ed71a1/language-en/format-PDF/source-68138393)

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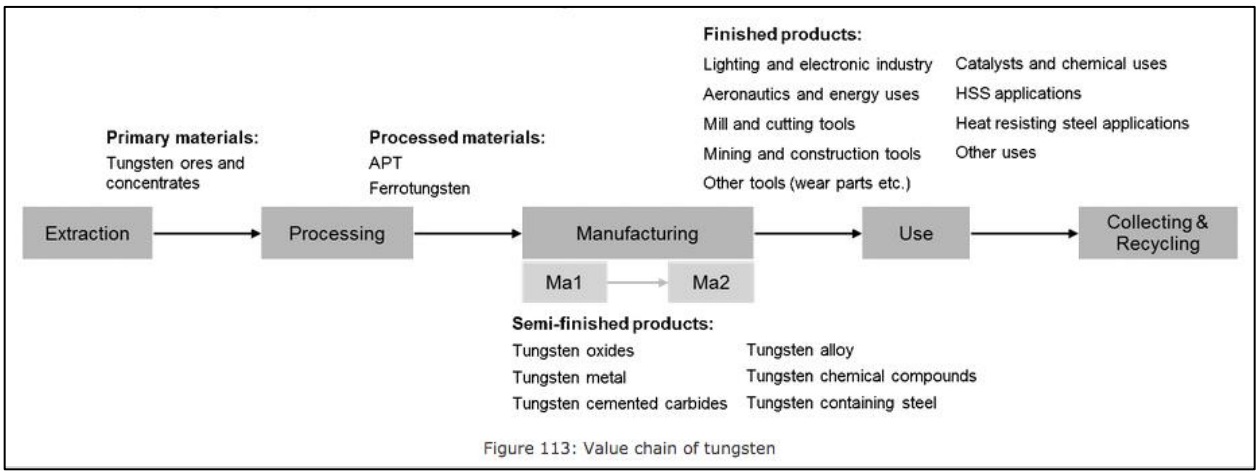
3. Tungsten

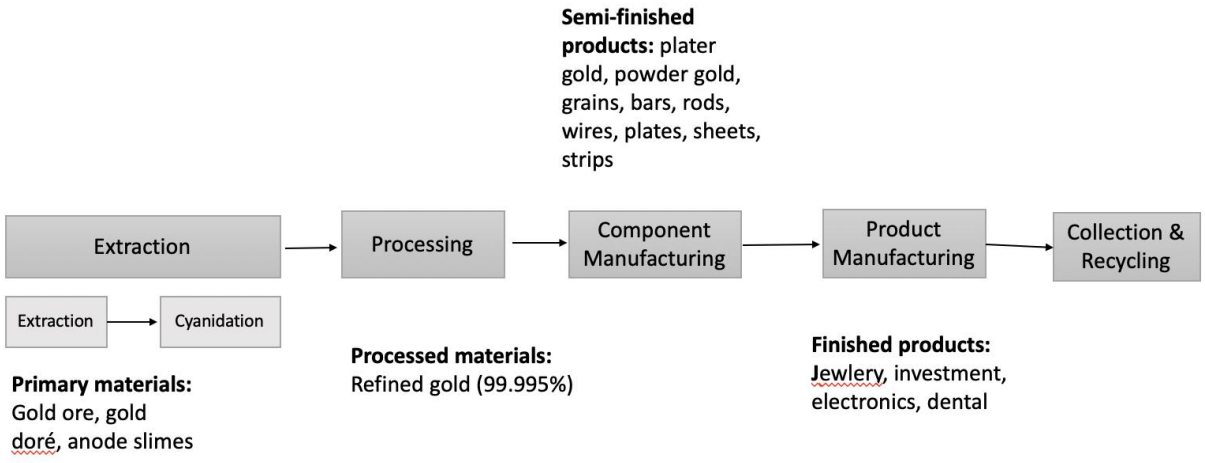
Figure 5: Simplified tungsten value chain



(Source: European Commission Raw Materials Information System, accessed on http://rmis.jrc.ec.europa.eu/?page=mfa-inventory-fc6a02#/materials/tungsten)

4. Gold

Figure 6: Simplified value chain of gold



(Source: European Commission Non-Critical Material Factsheet on gold, p.117, accessed on https://publications.europa.eu/en/publication-detail/-/publication/6f1e28a7-98fb-11e7-b92d-01aa75ed71a1/language-en/format-PDF/source-68138393 and World Gold Council, accessed on https://www.gold.org/about-gold/gold-supply/gold-refining)

5. Cobalt

Figure 7: Simplified cobalt value chain

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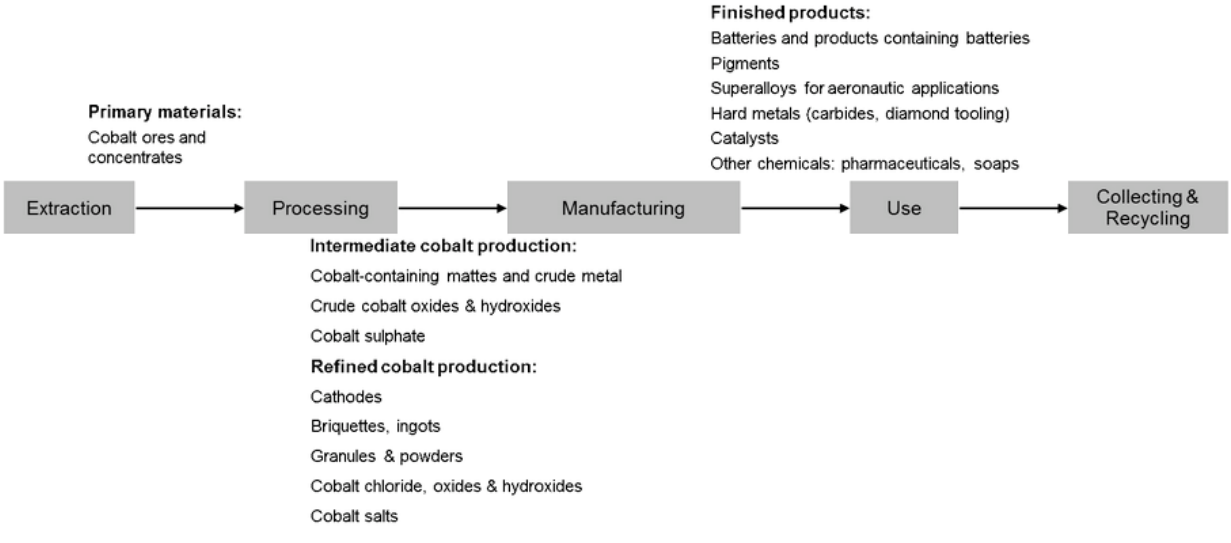

Figure 27: Value chain of cobalt

(Source: European Commission Raw Materials Information System, accessed on http://rmis.jrc.ec.europa.eu/?page=mfa-inventory-fc6a02#/materials/cobalt)

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